PHYS 201 Fall 2015

Course meets MWF 9:00 a.m. in GRB W211

Instructor: F. Barry Dunning, fbd@rice.edu

Office: 320 Brockman Hall

Phone: 713 348 3544

Office hours: Friday 2:00-4:00 p.m.

Associated laboratories (must register separately):

Stanley A. Dodds dodds@rice.edu

Office: 215 Herzstein Hall

Phone: 713 348 2510

Main Text: Hecht, *Optics*, Addison Wesley

Additional texts on reserve in the Fondren Library

French, *Vibrations and Waves*

Pedrotti, *Introduction to Optics*

Pain, *The Physics of Vibrations and Waves*

Web page https://owlspace-ccm.rice.edu/portal/site/PHYS-201

General information

The purpose of this course is to introduce students to waves, the properties of waves, and to electromagnetic waves, i.e., light. A thorough understanding of the nature of wave motion is essential for all branches of physics and most engineering disciplines. The wave properties of particles form the cornerstone of modern fundamental theories of matter (quantum mechanics) that will be discussed in PHYS 202

Grades

The final grade in this course will be determined as follows:

Exam 1	15%
Exam 2	15%
Final exam	25%
Pledged problems	20%
Suggested problems	25%

E**xams** will be timed take-home exams. The exams will be made available via the department office in Brockman Hall during the specified exam periods. The exams will be pledged in accordance with the Rice Honor Code. You may not collaborate with other students on the exam or use resources other than your own notes, a non-programmed calculator, and standard mathematical tables. All other resources including the web are banned. Solutions will be posted on the course web site. Exams (and other assignments) will be returned via the pigeon holes in Brockman Hall.

Pledged problems will be distributed periodically in class and will be available in the department office in Brockman Hall. These are intended to give you experience working completely on your own problems typical of those that will appear on exams and are subject to the honor system. In working the pledged problems you may consult your own notes, your textbook, and a calculator or standard mathematical tables; all other resources (including the web and solutions from previous years) are banned. Your hard copy solution should be placed, before the deadline, in the box marked PHYS 201 in Brockman Hall. Solutions will be placed on the course website.

Suggested problems will be posted periodically on the course web site and will be available in the department office in Brockman Hall. These will provide experience in problem solving and in the use of concepts discussed in the course. They are selected to help you prepare for the pledged problems and exams. You are encouraged to discuss these problems with fellow students, tutors, and the instructor. They are not pledged but the final solution you turn in should be your own work and not copied directly from another student. Solutions should be placed, before the deadline, in the box marked PHYS 201 in Brockman Hall. Solutions will be posted on the course website.
Actually doing problems is the way to learn the material. The text book provides some worked examples, and some will be done in class, but actually thinking about, setting up, and solving problems yourself is the best way to become proficient and develop a full understanding of the material.

Make-ups and excused days. Make-ups for missed homeworks and exams will be given at the discretion of the instructor. If you have university business or a conflicting class, or a serious personal problem (illness, a death in the family,..) notify the instructor beforehand in writing or by email.

Students with Disabilities. Any student with a documented disability seeking academic adjustments or accommodations is requested to speak with the instructor during the first two weeks of class. All such discussions will remain as confidential as possible. Students with disabilities are encouraged to also contact Disability Support Services in the Allen Center (e-mail: adarice@rice.edu, phone: 713 348 5841) during the first two weeks of class so that timely and appropriate arrangements may be made.

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Syllabus

- **Harmonic motion:** simple harmonic motion, complex numbers, damped simple harmonic motion, quality factor Q, driven harmonic oscillators, power input, resonance – *base treatment of that in French (on reserve), some discussion in Serway & Jewett*
- **Traveling Waves:** wave equation, transverse waves on a string, energy transport, characteristic impedence, superposition, transmission and reflection at boundaries, standing waves, wave groups, phase and group velocity
- **Electromagnetic waves in three dimensions:** Maxwell's equations in differential form, plane waves, wave equation for em waves, velocity of em waves, dispersion, extinction, energy transport by an em wave, Poynting's vector, momentum of an em wave, radiation pressure, generation of em waves. We consider in detail one specific em wave, light.
- **Propagation of light:** Huygen's principle, reflection and refraction, Snell's law, Fermat's principle, Stokes's relations, Fresnel's equations
- **Geometrical optics:** mirrors, prisms, lenses, optical systems, optical instruments, aberrations, matrix methods (used for lasers/resonators)
- **Polarization:** linear polarization, circular polarization, angular momentum of an em wave, polarizers, retarders, quarter and half wave plates
- **Interference:** Young's double slit, thin film interference, wedge films, Newton's rings, Michelson interferometer, multiple beam interferometers, Fabry-Perot etalon
- **Diffraction:** Fraunhofer diffraction, diffraction gratings, Fresnel diffraction patterns, zone plates